Chemistry Quiz
Aqueous Solutions: Properties and Reactions
Instructor's Version B

Answer Sheet

1.	D
2.	A
3.	E
4.	C
5.	D
6.	D
7.	A
8.	B
9.	A
10.	D

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Chemistry Quiz
Aqueous Solutions: Properties and Reactions
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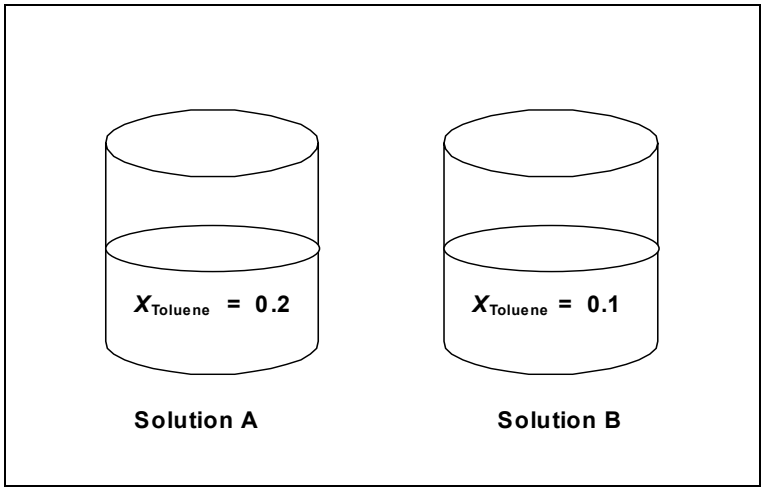
Free-Response Questions

Time Limit: You have 30 minutes to complete this section.
Scoring: 60 points total; each question is worth 30 points; points for each section are indicated within the questions.
Calculator Use: You may use a calculator on both questions.

1. Two solutions are shown below, each containing a mixture of toluene and benzene, in the proportions shown.



benzene, C_6H_6
d = 0.8765 g/mL
P_{vap} = 384 torr (60°C)
FW = 78.12 g/mol

toluene, $C_6H_5CH_3$
d = 0.8669 g/mL
P_{vap} = 133 torr (60°C)
FW = 92.15 g/mol

A. Which of the following will most readily dissolve in any mixture of toluene and benzene? Why? (10 points)

Methanol
SF_4
BBr_3

Answer

BBr_3 is nonpolar, therefore it will dissolve most readily in the nonpolar solvents toluene and benzene. SF_4 is see-saw shaped and polar; Methanol is bent around the oxygen and polar.

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B. Which of the two solutions (A or B) has a lower boiling point? Why? (10 points)

Answer
Solution B will boil at a lower temperature.

A substance or solution boils when its vapor pressure equals that of the external pressure.

Benzene has a higher vapor pressure than toluene. So the solution with the higher mole fraction of benzene will have a higher vapor pressure at a lower temperature, and therefore boil first.

C. What would the mole fraction of toluene be in a solution for which the partial pressure of benzene equaled that of toluene? Assume only toluene and benzene vapor is present. (10 points)

Answer
$P_b = P_t$

$X_b = 1 - X_t$

$P_b = X_b \cdot P_b^{\circ}$

$P_t = X_t \cdot P_t^{\circ}$

Making substitutions,

$P_b = (1 - X_t)\ (384)$

$P_t = (X_t)\ (133)$

$P_t = P_b$ therefore $(1 - X_t)\ (384) = (X_t)\ (133)$

$X_t = 0.743$

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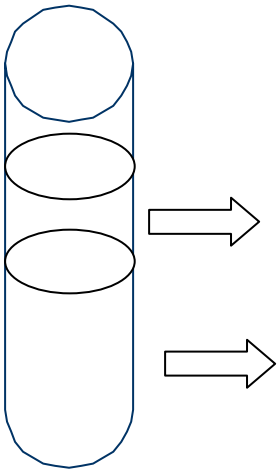
2. The physical properties and reactivity of halogens and other compounds are investigated.

A. 10.0 mL each of methanol (CH_3OH; d = 0.7914 g/mL), cyclohexane (C_6H_{12}; d = 0.7785 g/mL), and water are mixed together in a large test tube. A small amount of $CuBr_2$ (s) is added. Sketch and explain the appearance of the mixture after thorough mixing. (Cu^{2+} is a blue-green color). (10 points)


10 mL cyclohexane; nonpolar, not miscible with water
~20 mL water and methanol; both polar and miscible; also Cu 2+ and Br - ions (polar); this phase is blue-green in color.

B. Next, gaseous Chlorine is bubbled through the mixture in part A. Once the mixture is shaken, the following redox reaction occurs:

$$CuBr_2\,(aq) + Cl_2\,(g) \rightarrow CuCl_2 + Br_2$$

Sketch and explain the appearance of the mixture after thorough mixing. (10 points)

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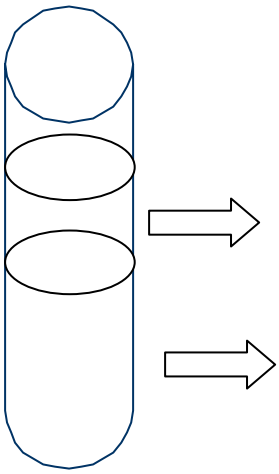


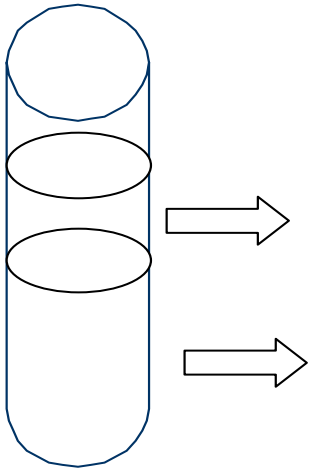
Now a reddish brown color; now contains nonpolar Br2

The same except now contains Cl- ions instead of Br-. Still blue-green.

C. Finally, A small strip of Magnesium is dropped into the test tube. The following reaction occurs:

$$CuCl_2\ (aq) + Mg\ (s) \rightarrow MgCl_2 + Cu$$

Sketch and explain the appearance of the mixture after thorough mixing. (Mg^{2+} is colorless). (10 points)



Same as in B.

The blue color is less or gone. Some solid Cu may be seen on the bottom. Now contains Mg 2+ ions instead of Cu 2+ ions

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